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COTTONSEED QUALITY AS AFFECTED BY THE GINNING PROCESS--

A PROGRESS REPORT

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INTRODUCTION

Cottonseed and other agricultural products are subjected to mechanical processing from origin to final destination. Each time cottonseed is handled mechanically, it may be damaged and lowered in quality.

Approximately 6 million tons of cottonseed are produced annually in the United States. Of this amount, 5.75 million tons, or about 96 percent, are utilized by the cottonseed oil industry. The remaining 250,000 tons of seed are used for planting new crops.

The overall quality of cottonseed needs to be good. However, the cottonseed used for planting is generally considerably higher in quality than that utilized by the oil industry. Seed for planting is necessarily high in quality because of its relatively high money value and because the various seed-certifying agencies and seed-control officials have somewhat rigid requirements regarding the sale of such seed. From the time it is harvested until it is used, cottonseed intended for planting is probably subjected to more mechanical action than any other kind of agricultural seed.

Mechanical harvesters are the first source of damage to cottonseed. After harvesting, seed cotton is passed through numerous cleaners and several hundred feet of pneumatic conveying systems at the gin. After seed and fiber are separated, the seed receives additional handling when it is conveyed from the gin into storage or other facilities. Additional damage may occur in delinting plants. In these plants, cottonseed is subjected to the mechanical action of various cleaners and delinting machines. Thus, from the time the seed is removed from the cotton plant until it is placed in the farmer's planter, numerous machines and conveying systems are hazards that may damage the seed.

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As a result of the rapid rates used in harvesting and ginning cotton and in the handling of the seed, farmers who use planting seed and merchants in the seed industry have become concerned about the effects that these processes have on cottonseed quality. During the 1963 ginning season, the U.S. Cotton Ginning Research Laboratory began studies to determine the effect of these various operations upon seed quality.

TEST PROCEDURE

Samples for seed quality evaluation were collected at seven gin plants in Louisiana and Mississippi. Six of the plants utilized high-capacity machinery, and one plant had conventional machinery. High-capacity plants using equipment made by each of the five major gin machinery manufacturers were selected for study. The machinery sequence at each plant generally was as follows: Automatic feed control, tower drier, cylinder cleaner, extractor, tower drier, cylinder cleaner, extractor-feeder, gin stand, two stages of saw-type lint cleaning, condenser, and baling press.

Ten bales of machine-picked cotton were sampled on each of three different dates during the 1963 ginning season at each of the six gin plants. At the remaining plant, located in an area where both machine- and hand-picked cottons were available, the sampling procedure consisted of sampling 5 bales of hand-picked and 5 bales of machine-picked cotton on three different dates during the 1963 season. Each bale was sampled at the following locations in each gin plant: (1) At the unloading station before cotton entered the plant, (2) at the extractor-feeder after cotton had passed through the various seed cotton cleaners and driers, and (3) at the seed conveyor immediately after fiber and seed separation. These samples were analyzed for seed quality and moisture content. Seed samples were also collected for linters analysis. In addition, lint samples were taken before and after lint cleaners for seedcoat-fragment analysis. Processing rates were measured for each bale sampled. Cotton varieties were also noted for each bale.

The samples collected for moisture, linters, and seedcoat-fragment determinations were analyzed according to standard laboratory procedure. Seed quality samples from both seed cotton and cottonseed were acid-delinted and analyzed for germination, damaged seed, and abnormal seed. To eliminate sample variation in seed germination percentages caused by immature seed and to remove all immature seed before germination tests were conducted, all seed samples were blown on a South Dakota Seed Blower.[3/] For the purposes of this study, a damaged seed is one that has any visible damage to the seedcoat after being acid-delinted.

3/ Trade names are used in this publication solely for the purpose of providing specific information. Mention of trade name does not constitute a guarantee or warranty of the product by the U.S. Department of Agriculture or an endorsement by the Department over other products not mentioned.

Seed damage percentages for each sample were established by visually observing each of the 200 seeds used in the standard germination tests and by noting the number of seeds that had physical damage to the seedcoat. Seedlings that did not possess essential structures that were indicative of their ability to produce normal plants under favorable conditions were classified as abnormal.

Additional laboratory testing was conducted during the 1963 ginning season to determine the effect of excessive handling on the quality of cottonseed. In general, the test procedure consisted of passing a given lot of gin-run cottonseed through a typical cotton gin seed-handling system 1 to 20 times. After each pass through the seed-handling system, samples were drawn for seed quality analysis. The seed-handling system used for this study consisted of the following equipment: An 8-inch seed belt; a 12-inch seed dropper; a 28-inch turboblower; five 90° elbows each 5 inches in diameter and having a 36-inch radius; two 45° elbows each 5 inches in diameter and having a 36-inch radius; 150 feet of 5-inch-diameter pipe; a 36-inch cyclone; and a seed-weighing device.

TEST RESULTS

Results obtained from this study represent a broad overall view of the effect of the ginning process on seed quality. A more specific and thorough analysis of these data was prevented by two major uncontrollable factors encountered during the course of the study. These factors were the varietal and environmental differences that existed among the various gin plants. The results reported were obtained by disregarding these varietal and environmental factors.

Results of seed quality tests made on samples obtained from the seven gin plants are shown in table 1. No method was available for controlling the processing rate among and within the gin plants. Variations in rates occurred because of differences in operating procedures and differences in rated capacities of the gin plants.

Moisture content of the incoming seed cotton at the wagon averaged 11.0 percent for the seven gins. The average moisture content of the cottonseed was 9.9 percent.

Residual linters present on the seed ranged from 9.7 to 13.5 percent; they averaged 10.9 percent.

Test results indicate that lint cleaners remove approximately one-half of the seedcoat fragments and funiculi from ginned lint (table 1). No consistent correlations could be obtained between seedcoat fragments and funiculi content, germination, and damaged seed.

Table 1. Results of 1963 seed quality study

Item tested	Gin plant identification							Season average
	1	2	3	4	5	6	7	
Bales sampled---number-----	30	30	30	30	30	30	30	30
Processing rate---lb.lint/ saw/hr.----------	9.4	10.0	27.5	19.6	22.5	21.9	18.6	17.7
Moisture content:								
Seed at wagon--percent----	11.5	11.2	11.4	11.1	12.3	9.4	10.2	11.0
Seed at feeder--do--------	9.2	8.1	8.7	8.4	8.8	7.0	8.1	8.3
Cotton seed-----do--------	10.8	10.2	10.0	10.0	10.4	8.6	9.6	9.9
Residual linters-do--------	10.9	9.7	10.6	10.3	10.5	13.5	10.7	10.9
Seedcoat fragments and funiculi in lint:								
Before lint cleaning-do--	0.8	1.0	0.7	0.4	0.7	0.9	0.5	0.7
After lint cleaning--do--	0.3	0.5	0.3	0.4	0.5	0.4	0.4	0.4
Germination:								
Seed at wagon--------do---	88.5	90.0	82.7	81.8	81.0	87.2	91.0	86.0
Seed at feeder-------do---	84.3	88.4	75.4	81.7	79.0	88.5	84.9	83.2
Cotton seed----------do---	85.1	88.3	77.4	81.1	77.9	89.2	89.5	84.1
Damaged seed:								
Seed at wagon--------do---	4.1	5.1	4.1	4.4	5.9	3.4	2.7	4.2
Seed at feeder-------do---	5.3	4.6	5.5	6.2	6.4	3.3	3.8	5.0
Cotton seed----------do---	4.8	9.5	11.0	10.8	14.0	8.2	9.7	9.7
Abnormal seed:								
Seed at wagon--------do---	2.7	2.8	2.5	3.0	3.2	2.6	2.3	2.7
Seed at feeder-------do---	3.9	3.0	3.1	3.9	4.2	2.7	3.2	3.4
Cotton seed----------do---	3.7	3.2	4.0	4.9	4.8	3.5	3.3	3.9

Of all the factors considered in this analysis, seed germination is the most important single item in determining the quality of planting seed. Results of this study indicate that the ginning process is slightly detrimental to the germination qualities of the cottonseed. Germination increased from 83.2 to 84.1 percent as the result of the fiber and seed separation process and can be accounted for only as a result of the nonhomogenous nature of the cotton from which the samples were obtained.

The analysis of seed damage indicated that physical damage to the seedcoat increases as the mechanical handling of the seed increases during the ginning process.

The presence of abnormal seed also increased during the course of ginning. The average content of abnormal seed in the incoming seed cotton was 2.7 percent. The action of the various gin stands increased the content of abnormal seed to 3.9 percent.

Further analysis of the test data indicated that fairly consistent correlations could be obtained between the difference in damaged seed before and after processing and various other test items. These relationships are necessarily general in nature, because they are based on the seasonal average for the seven gin plants. The least square method of curve fitting was employed in establishing the relationships that follow.

Seed damage that occurs during the ginning process increases as the seed moisture contents increases (Fig. 1). Increased ginning rates also tend to increase the amount of seed damaged in ginning (Fig. 2). Seed germination was adversely affected as the percentage of damaged seed increased (Fig. 3).

Comparisons were also made to determine if there were any differences in the various seed quality factors between hand- and machine-picked cotton. The 15-bale seasonal average analysis indicated that hand-picked cotton had slightly higher germination percentages both before and after ginning than machine-picked cotton (table 2). For each sampling date, machine-picked cotton had a much higher percentage of damaged seed before processing than hand-picked cotton.

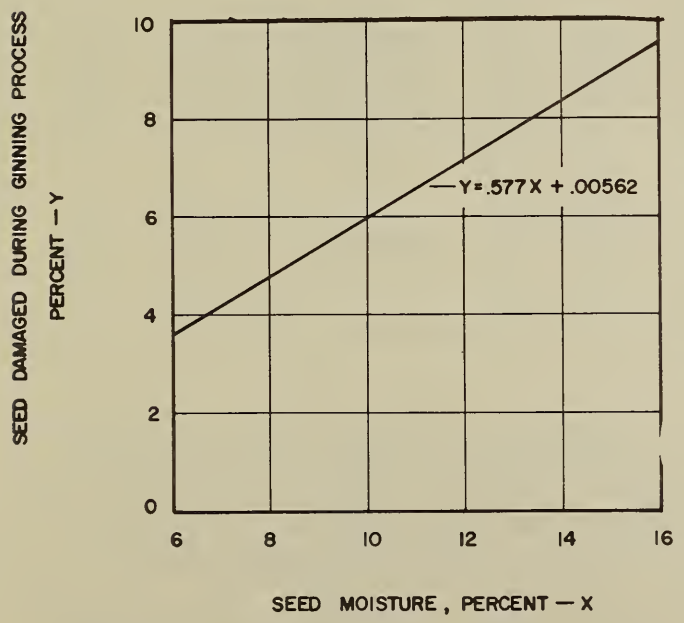

Figure 1. The effect of seed moisture on seed damaged during the ginning process.

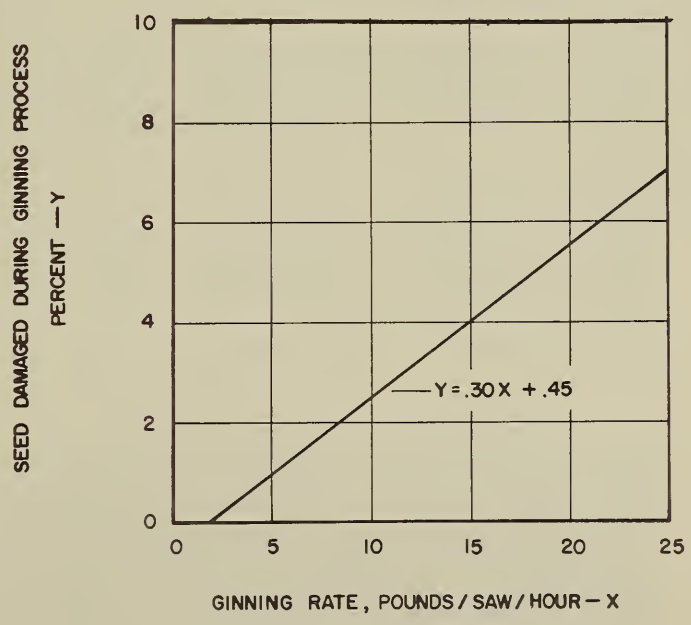

Figure 2. The effect of ginning rate on seed damaged during the ginning process.

Table 2. Comparison between hand- and machine-picked cotton for various seed quality factors

Item tested	Sampling date, 1963						Seasonal average	
	September 17		October 3		October 21			
Type of harvest	Hand	Machine	Hand	Machine	Hand	Machine	Hand	Machine
Number of bales sampled---	5	5	5	5	5	5	15	15
Moisture content:								
Seed at wagon---percent--	12.2	12.3	11.8	11.2	6.7	6.8	10.2	10.1
Seed at feeder-----do----	10.7	9.1	8.7	8.7	6.0	5.4	8.5	7.7
Cotton seed--------do----	12.3	9.9	10.8	11.0	7.1	6.7	10.1	9.2
Residual linters----do----	11.2	11.2	9.8	9.8	11.0	11.0	10.6	10.6
Seedcoat fragments and funiculi in lint:								
Before lint cleaning--do-	0.6	0.6	0.5	0.4	1.0	0.6	0.7	0.5
After lint cleaning---do-	0.4	0.3	0.3	0.3	0.4	0.3	0.4	0.3
Germination:								
Seed at wagon-------do----	96.0	92.1	93.8	92.2	85.3	86.8	91.7	90.3
Seed at feeder------do----	86.4	72.3	92.6	85.0	90.6	82.4	89.9	79.9
Cotton seed---------do----	90.0	88.4	89.2	87.8	94.1	87.2	91.1	87.8
Damaged seed:								
Seed at wagon-------do----	0.6	3.8	0.4	4.1	0.4	6.6	0.5	4.8
Seed at feeder------do----	2.0	3.3	4.0	7.6	2.7	3.5	2.9	4.8
Cotton seed---------do----	17.3	14.9	6.8	8.9	4.8	5.5	9.6	9.8
Abnormal seed:								
Seed at wagon-------do----	1.9	2.4	1.7	2.0	1.9	3.6	1.8	2.6
Seed at feeder------do----	3.0	4.3	2.3	3.3	2.8	3.4	2.7	3.7
Cotton seed---------do----	4.7	3.7	3.3	2.5	1.7	3.7	3.3	3.2

The seasonal average showed that 4.8 percent of the machine-picked cotton had the seedcoat damaged before any gin processing occurred, compared with only 0.5 percent for the hand-picked cotton. However, after cotton from both harvesting methods had passed through the various gin machines, differences in percentage of damaged seed resulting from the two harvesting methods were almost negligible (table 2).

Excessive handling of cottonseed in pneumatic seed-conveying systems may also be detrimental to seed quality. After twenty passes through a pneumatic

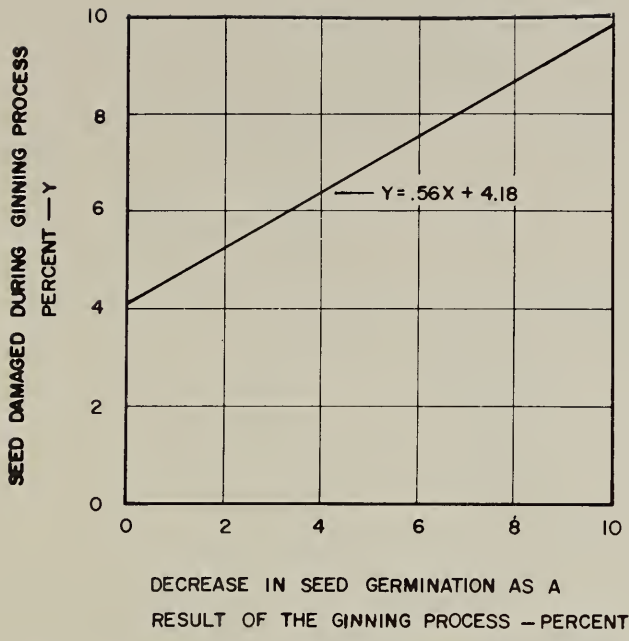

Figure 3. The adverse effect of damaged seed on germination.

seed-conveying system, germination decreased from 79.0 percent to 49.0 percent (Fig. 4). After the same treatment, seed damage increased from an initial 18.5 percent to 55.5 percent, and, abnormal seed increased from 7.0 to 21.5 percent (Fig. 5).

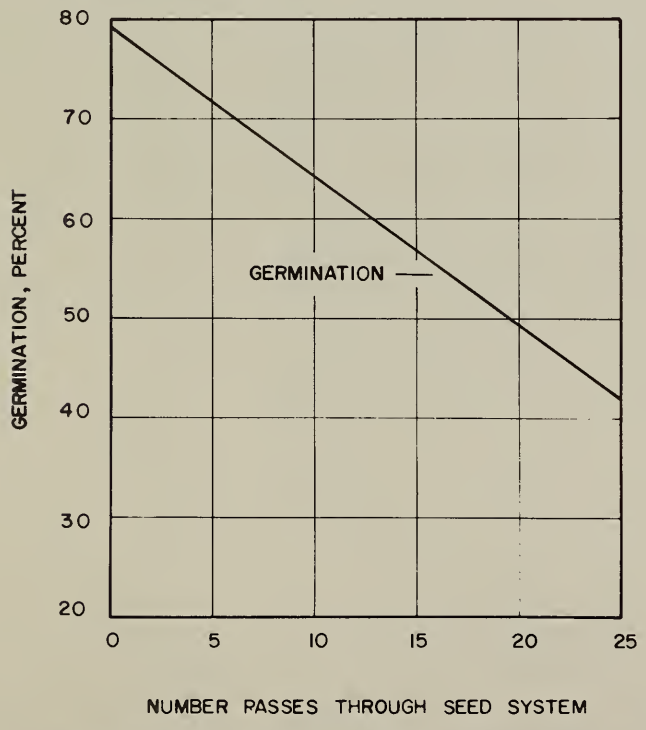

Figure 4. The effect of excessive handling on cottonseed germination.

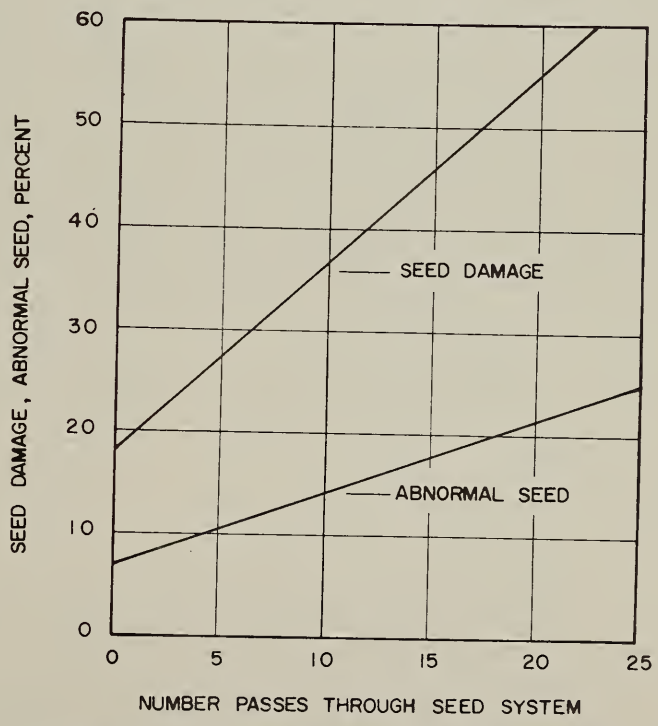

Figure 5. The effect of excessive handling on seed damage and abnormal seed.

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SUMMARY AND CONCLUSIONS

The effect of gin processing on cottonseed quality was studied at seven commercial ginning establishments in Louisiana and Mississippi during the 1963 ginning season. A total of 30 bales of cotton were sampled at each plant during the 1963 ginning season. Samples were taken from each bale before cotton entered the plant, after cotton had passed through various seed cotton cleaners and driers, and after the fiber had been separated from the seed. These samples were acid-delinted and analyzed for the various seed quality factors.

The following general conclusions were reached as a result of these studies:

1. The ginning process tends to decrease slightly the seed germination percentage.

2. The ginning process increases damage to the seed coat. Most of the damage occurs when fiber is separated from the seed--in the gin stand.

3. The ginning process increases the percentage of abnormal seed.

4. Mechanical harvesters lower seed germination percentages and increase the percentage of damaged and abnormal seed.

5. Excessive handling of cottonseed in pneumatic conveying systems lowers seed quality by decreasing seed germination percentage and by increasing the amount of damaged and abnormal seed.